Can Contracts Improve Production Efficiency in Agriculture?

Contracting may influence productivity by reducing production costs or raising production values. It does so by altering the incentives that market participants face, or by facilitating coordination among stages of production—speeding technology adoption, improving information flows, managing quality, uniformity, and delivery, or enhancing access to credit. Transactions-cost economics helps to explain spot market failure. If investment in specific assets carries risks of holdup, spot market participants may avoid those investments, as well as the resulting reductions in costs or improvements in product attributes. In that case, properly designed contracts may elicit such investments and overcome spot market failure.

Productivity improvements reduce farm costs by decreasing the quantity of inputs needed to produce a given level of output. Improvements in product uniformity, for instance, can allow the use of standardized dedicated equipment by farmers to lower harvesting costs or by processors to lower processing costs. Contracts can also be used to regulate product flows to processing plants, allowing processors to cut costs through more efficient use of plant capacity. Some contracts give farmers access to better seeds or improved livestock strains; these improved inputs lead to greater crop or meat yields from given quantities of other inputs, reducing per unit costs of production. But productivity growth may also result from developments that lead to more valuable outputs for a given level of inputs, providing greater customer satisfaction, such as corn that is more easily digestible as feed or meat with improved taste or tenderness.

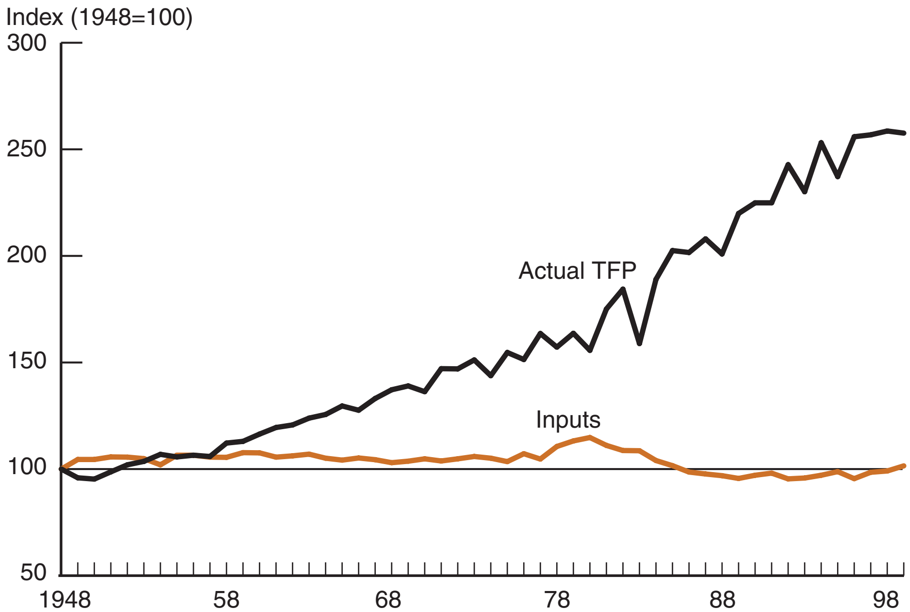
Examples follow from several agricultural sectors to show how contracts can be used to improve productivity. Some measures of productivity growth are called single factor measures, such as increases in crop production per acre or per labor hour, because they relate output growth to a single input. More complete measures are based on total factor productivity (TFP) and relate growth in the volume or value of output to growth in all inputs. TFP measures are preferred because some innovations reduce use of one input by increasing the use of others. Thus focusing on a single input to the exclusion of others may result in misleading inferences about the effects of an innovation on costs. However, because of data limitations, TFP measures are often unavailable; in those cases, single factor measures are used and can be informative if applied with care.

Agricultural Productivity Growth in the Aggregate

Figure 5-1 shows annual nationwide data on agricultural input use and TFP developed by ERS (Ball, 1985; Ball et al, 1997). Between 1948 and 1999, agricultural TFP grew at an annual rate of 1.9 percent per year, much higher

Figure 5-1

U.S. agricultural productivity growth, 1948-98



Source: U.S. Department of Agriculture, Economic Research Service.
(www.ers.usda.gov/Data/AgProductivity/)

than in most sectors of the economy. Much of that growth can be traced to the development and diffusion of improved inputs—mechanical inputs such as faster and more powerful tractors, biological inputs such as new seed types or improved livestock genetics, or chemical inputs such as new or more effective fertilizers and pesticides. Formal private and public investments in research and development often led to the invention and development of input improvements.

Cochrane (1993) argues that a watershed in agricultural production was reached around the early 1980s, leading to greater integration between the stages of production and additional control over the production process. He asserts that productivity increases after 1980 arose not only from new technologies (such as hybrid seed or increased fertilizer use), but also from more controlled and effective use of resources. Cochrane relates this to management innovations that improved efficiency of the production process and sped the adoption of technological innovations. He emphasizes new information technologies, but contracting, by facilitating the adoption of new technologies and improving on the incentives offered by spot markets, may be an important element of these managerial innovations.

Recent ERS research lends some support to Cochrane's position. Ahearn, Yee, and Huffman (2002a) investigated the sources of differences in agricultural productivity growth in the 48 contiguous U.S. States between 1978 and 1996. The authors developed an indicator of contract use: the share of a State's farms that had production contracts. Other indicators of structural change in a State's agricultural sector included measures of entry and exit in farming and changes in size among farms continuing to operate. The measures of structural change and productivity were developed from data in the Census of Agriculture. The measures are not ideal—no information on marketing contracts or on the share of production under contract was available. Surveys that do have such information only cover recent years. Nevertheless, the structural change measure does seem to match well with what we know about the temporal spread of contracting in general and of the commodities involved.

Ahearn and her colleagues found that a higher incidence of contracts was associated with faster productivity growth and with increases in average farm size. The association was modest—a 10-percentage point increase in the incidence of contracts was associated with a 9-percent increase in productivity—but the estimate was statistically significant. Ahearn's measures of structural change were also associated with productivity growth—faster productivity growth was linked to entry and exit and rapid increases in farm size. (Transactions-cost explanations for contracting argue that technological change that leads to larger operations may also lead to a greater reliance on contracting.)

The connection between contracts and advances in productivity appears to be stronger in 1978-96, in line with the findings of Cochrane; in other work extending over the period from 1948 to 1996, Ahearn, Yee, and Huffman find that the effect of contracts is much smaller and is not statistically significant (2002b). Their analysis suggests that there may be important systemic connections among recent technological changes in agriculture, structural changes in contracting and farm sizes, and productivity growth. However, the highly aggregated data they used were not designed for purposes of these analyses and cannot show precisely how these factors might be linked. For more insight, we turn to studies of particular commodities.

Contracts, Technology Transfer, and Productivity: Farm-Level Studies in Livestock

Contracting in the livestock sector may have led to sharp increases in productivity by facilitating the adoption of new technology. (While not the focus of this report, contracting may also exacerbate environmental risks. See Box 3: Livestock Contracting, Structural Change, and Environmental Effects.) We summarize the evidence below.

Hogs

Contracts that reduce risks may also lower grower productivity. However, the rapid diffusion of contracted production throughout the industry suggests that contracts may offer efficiency advantages over independent production. Key and McBride (2003) pursued this issue with data on nearly 500 hog producers from USDA's 1998 ARMS. Specifically, they compared productivity in production contracts and independent feeder pig-to-finish hog operations. Their econometric analysis controlled for a variety of farm and operator characteristics, including farm and hog enterprise size, location, and operator age, education, and experience.

Because the study focuses on finishing operations that take young pigs (30-80 pounds) and feed them to market weight (200-280 pounds), productivity

Box 3—Livestock Contracting, Structural Change, and Environmental Effects

Structural change in livestock production encompasses several elements. Modern "confined animal feeding operations," or CAFOs, are much larger than livestock operations of the past in order to realize lower production costs from economies of scale. The operations are also quite specialized. They frequently receive livestock feed from an integrator or purchase it themselves, thereby severing the on-farm linkages between crop production and livestock feeding and reducing associated on-farm land requirements. They also commonly specialize in one stage of livestock production. Finally, CAFOs are more likely than other producers to rely on contracts to control genetics, ease financing, and limit the risks of investing in a large enterprise. In that sense, contracts further structural changes toward larger and more specialized livestock feeding operations.

Structural change is occurring because growers realize lower production costs on CAFOs, leading to lower livestock prices for processors and lower meat prices for retailers and consumers. However, because CAFOs concentrate livestock wastes in a limited land area, they may also have a considerable environmental impact on nearby surface and ground water sources (resulting from a concentration, rather than an increase, of wastes). If this change in livestock production leads to lower meat prices, it will increase meat consumption, and therefore animal production and the nationwide volume of animal wastes. That development is offset, however, to the extent that improved feed efficiency, one major source of lower costs, reduces waste production per animal.

Wastes are typically collected in lagoons prior to field application. The lagoons are at risk of leakage and catastrophic breaks that can lead to major pollution in nearby waterways and ground water. One way to manage animal waste is to apply it to fields to help meet crop nutrient needs. However, specialization in livestock means that many CAFOs have limited land devoted to crop production, and individual producers may apply nutrients contained in animal wastes in excess of the amounts that vegetation can utilize. Thus, some large producers may have more interest in disposal than optimal crop production, leaving the excess nutrients to run off to surface water or leach into ground water.

Environmental risks associated with runoff from excess animal wastes vary with the type of animal and the region of the country, and also appear to vary with the type of operation. McBride and Key (2003), analyzing 1998 data on hog producers, found that larger operations generally have far less land per animal than smaller operations and that substantial numbers of large hog operations, particularly in the Southeast, appear to apply nutrients to land at rates in excess of the amounts that crops can use.

Hog and broiler production contracts usually assign the grower with responsibility for handling manure and dead animals, along with liability for damages associated with each. However, recent lawsuits seeking damages from odors from hog and poultry manure have targeted contractors (as in an Alabama suit against Tyson Foods and a Minnesota suit naming Wakefield Farms), as well as their contracted livestock-growing operations. With contractors facing increasing likelihood of regulation and tort liability themselves, some contracts now contain more detailed specifications for the control and application of animal wastes.

indicators measure weight gain per unit of input. Table 5-1 shows that production per dollar of all input expenses averaged 52 percent higher for contract compared with independent (spot market) operations. As is common in analyses of farm data, there is a wide spread of actual performance around the average, and some independent operations are quite efficient. However, the differences are statistically significant and quite large—contracting status has strong effects, on average. Contract operations are usually much larger than independent ones, and larger operations also tend to have higher productivity. However, when Key and McBride controlled for differences in farm size, they found that contract enterprises still had large productivity advantages over independents—output per dollar of input expenses was 23 percent higher in contract enterprises with the same size, location, and operator characteristics as independents.

Why do contract enterprises have higher productivity and lower costs? While contract operations use labor more effectively—production per labor hour was much higher—labor accounts for only a small share (8 percent) of total costs. The driving force in contracting's productivity advantage was feed efficiency. Feed accounted for two-thirds of the cost of raising animals to slaughter weight, and production per pound of feed was 36 percent higher in contract compared with independent operations of similar size and operator characteristics.

The gap in total factor productivity (TFP) between contract and independent growers (23 percent) is less than the single-factor productivity gaps. One reason could be that contract operations pay higher prices for inputs such as feed, possibly because many of the independents are located in the Corn Belt, while many contract operations are outside it. Price differences matter because TFP in this study is a dollar measure—output per dollar of expense—while the single-factor measures reported here are in physical units such as output per pound of feed or per labor hour.

Table 5-1—Productivity and contracting in hog production

Efficiency measure	How measured?	Average increase under contract production	Average increase under contract production, controlling for other factors	Share of input in total costs
			Percent	
Total Factor Productivity (TFP)	Production per dollar of inputs	52	23	na
Feed	Production per pound of feed	61	36	66
Labor	Production per hour of labor	234	44	8

Notes: na = not available. Production is the combined weight of all hogs sold or removed under contract less the combined weight of all hogs purchased or placed under contract, plus the combined weight of inventory change. The column labeled "average increase under contract production" compares means for contract and independent operations. The next column compares means, while controlling for the effects of the size and location of the hog operation and age, education, experience, and primary occupation of the operator.

Source: Key and McBride (2003).

How do contract operations achieve such large gains in feed efficiency? One answer is that contracts can ease a grower's credit needs and access. Many production contracts provide such a large share of production inputs that they sharply reduce overall grower credit needs, and banks may be more willing to advance loans before production because of the more certain revenue flow provided by a contract. Eased credit allows for greater size, which may allow scale efficiencies, and production contracts that cover the provision of inputs reduce both the cost of searching for inputs and the risks associated with input price and the necessary credit arrangements to buy inputs.

Contractors may deliver more effective and appropriate feed mixes than those that independent growers feed to their hogs. Feed efficiency also depends on genetics, and integrators control hog genetics in typical contracts by retaining the exclusive right to supply pigs to the grower.[1] Finally, contracts provide a framework for transferring information and training to growers. Contracts frequently require growers to attend training courses and seminars on hog production and to follow integrator-provided procedures, guidelines, recommendations, and advice.

[1] Examples of hog finishing contracts can be found at the Iowa Attorney General's electronic collection of agricultural contracts. (*http://www.state.ia.us/government/ag/ag_contracts/index.html*)

Changes in hog genetics arising from private and public research, along with related improvements in production practices and feed mixes, are important drivers of industry-wide productivity growth. Key and McBride's research suggests that organizational shifts toward expanded contracting are also important elements in productivity growth, because they provide a means for applying new genetics, feed mixes, and production practices.

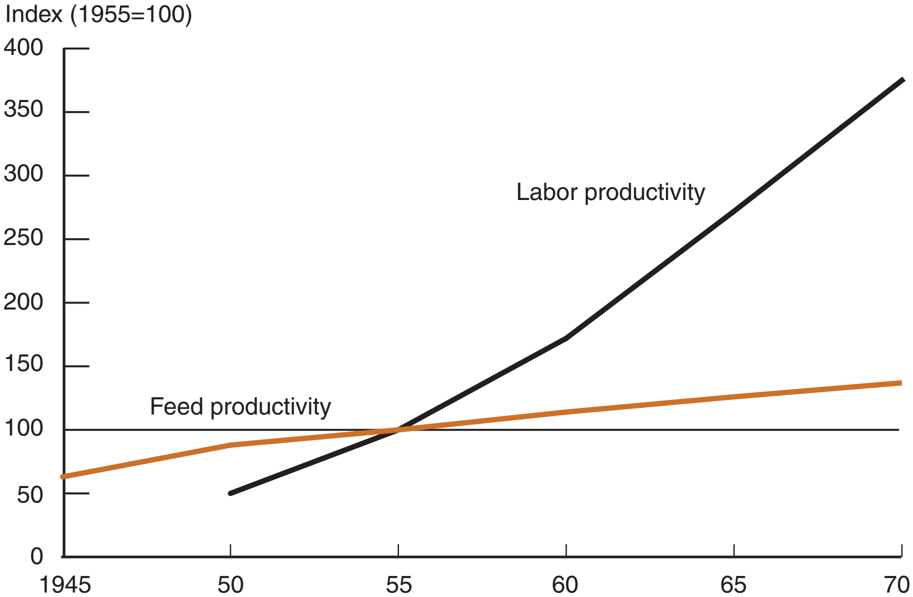
Broilers

Since contract broiler production dominates the industry, we cannot compare independent and contract broiler producers. However, industry-level analyses suggest that contracting delivers productivity-enhancing technology to the sector.

Research led to a number of basic advances in poultry breeding, nutrition, and disease control in the late 1940s and early 1950s (Reimund, Martin, and Moore, 1980). New fast-growing strains of chickens, bred specifically for meat production, were developed, along with newly formulated rations mixed for specific classes of poultry in different stages of growth. New vaccines and antibiotic feed additives limited the onset and effects of diseases, and mechanical innovations led to improvements in housing, waste removal, and materials handling. Other research allowed better sexing of the chicks and better candling of hatching eggs during incubation, along with examination for clear (unfertilized) eggs or dead embryos.

The innovations led to striking industry-wide productivity improvements, as measured by two single-factor indicators (fig. 5-2). Feed efficiency more than doubled between 1945 and 1970, while labor productivity rose 10.5 percent per year, on average, between 1950 and 1970. Organizational changes, in the form of larger farms and contracting arrangements, were necessary vehicles for spreading the new technologies (Knoeber, 1989; Lasley, 1983; Martinez, 1999; Reimund, Martin, and Moore 1980; Rogers, 1979).

Figure 5-2
Productivity growth in U.S. broiler production, 1945-70



Source: Reimund, Martin, and Moore (1980).

Production contracts reduced both the risks and the financial commitments faced by growers. As with hogs, integrators made the investments to improve broiler genetics, and they also developed and controlled appropriate feed mixes through contracts. They transferred information as well as production and management technology through contract guidelines and requirements.

Knoeber (1989) argues that the particular design of contracts found in broiler production—relative performance contracts—was an important element in diffusing technological advance. Grower payments depend on the grower's relative performance with a given flock of chicks, compared with a control group of growers in the area. Performance is largely driven by the effectiveness with which growers convert feed to poultry meat, which in turn depends on mortality in the flock and on feed efficiency for surviving birds. Knoeber further argues that the contracts played an important role in encouraging the diffusion of new technology for two reasons. First, the high rate of technological change in the industry led to some risk in using a new technique—it may not work. Contracts shifted the risks of developing and introducing new broiler technologies from producers to integrators. After cutting-edge farmers tried a new technology and affirmed its effectiveness, the contracts' performance clauses encouraged adoption and diffusion by growers. Second, the growers who can adapt most effectively to new technologies will likely gain the highest longrun returns under relative performance contracts. Such contracts may serve as tools to attract and retain effective growers.

Contract Design, Incentives, and Institutions for Product Quality in Crops

As noted, production contracts may be vehicles for productivity growth in livestock. Such contracts often contain explicit components governing the transfer of technology and the farm production process. However, production contracts covered only 2.8 percent of crop output in 2001, while marketing contracts were far more important, covering 23.4 percent of the value of 2001 crop output (table 2.7). Marketing contracts rarely contain detailed rules for input use and production, but instead focus primarily on pricing mechanisms that shift risks, offer greater returns for higher product quality, or ensure market outlets for farmers and steady commodity flows for buyers.

Marketing contract designs can raise productivity if they provide more effective incentives to produce higher valued crop varieties. If compensation is tied to product attributes, either accurate measurement of those product attributes is required or contractual specifications must provide assurance of production practices. Moreover, production of specific attributes can often create limited markets and holdup risks, leading to a reliance on contracts. Complicated contract designs require participants (producers and buyers) to pay close attention to the means of measuring performance, and the setting of payments. We turn to examples from several crops.

Tobacco

All major cigarette companies currently contract for tobacco. Cigarette production requires a particular blend of tobaccos, and contracting provides a way for manufacturers to get varieties with desired qualities. The shift to contracting occurred shortly after the November 1998 agreement between the major cigarette manufacturers and the Attorneys General of several States, under which the companies agreed to pay 46 States about $87 billion to compensate for Medicaid health expenses (Cutler et al, 2000). The payments would be financed through higher cigarette prices. The agreement also restricted certain forms of cigarette promotion.

Tobacco contracts are not standardized across companies, but most include provisions about quality, quantity, ownership, production standards, prices and payment, and enforcement. One key contracting issue is the relationship between price and quality. In general, buyers are willing to pay for higher quality, which generally costs more to produce. Tobacco contracts contain strong incentives to improve tobacco quality, and it is possible that cigarette manufacturers sought to raise quality in order to offset the effects of the Compensation Agreement's price increases and marketing restrictions on cigarette demand.

Growers can affect tobacco quality only to an extent, through their choices of farming, harvesting, curing, and sorting techniques. By paying prices based on quality, contracts can give growers incentives to increase the share of high-quality tobacco and decrease the share of low-quality tobacco in each crop.

A comparison of auction and contract price data indicates that tobacco contract pricing rewards high quality and punishes low quality. Table 5-2 compares auction market and contract prices for quality grades of five standard tobacco products. The products are leaves from different parts of the stalk, with primings at the bottom, cutters in the middle, and tips at the top

Table 5-2—Contracting and product quality in tobacco

Product	Contract grade	Contract price	Auction prices Mean	Minimum	Maximum
		Dollars per pound			
Primings	1	1.66	1.56	1.53	1.59
	2	1.61	1.52	1.34	1.58
	3	1.51	1.46	1.34	1.52
	4	1.14	1.37	1.34	1.40
Lugs	1	1.78	1.67	1.65	1.68
	2	1.71	1.60	1.54	1.65
	3	1.64	1.49	1.37	1.54
	4	1.14	1.43	1.37	1.45
Cutters	1	1.88	1.78	1.76	1.79
	2	1.82	1.71	1.62	1.79
	3	1.75	1.60	1.43	1.66
	4	1.14	1.48	1.43	1.56
Leaf	1	1.96	1.94	1.91	1.94
	2	1.92	1.90	1.80	1.95
	3	1.87	1.79	1.45	1.87
	4	1.83	1.69	1.45	1.89
	5	1.20	1.56	1.09	1.69
Tips	1	1.95	1.92	1.83	1.94
	2	1.91	1.89	1.79	1.94
	3	1.77	1.68	1.29	1.88
	4	1.20	1.49	1.09	1.69

Note: The products are tobacco leaves distinguished by their position on the stalk of the tobacco plant, with primings at the bottom (nearest the soil), followed in order by lugs, cutters, leaf, and tips.

Source: Dimitri (2003).

(lugs are between primings and cutters, while leaves are between tips and cutters). Lower grades (1, 2) are associated with higher quality. The table reports contract prices, as well as average (mean), minimum, and maximum auction prices. In general, tobacco contracts offered higher price premiums for quality than those in auction markets, and larger price discounts for low-quality tobacco. Contract prices for the highest quality, grade 1, exceed average and maximum auction prices in each product, while contract prices offered for the poorest quality grade (grade 4, and grade 5 in leaf tobacco) are substantially lower than the lowest auction price for primings, lugs, and cutters and well below the average auction price offered for leaf and tips. It appears that spot market pricing systems provided weaker incentives to producers to grow higher quality tobacco than contract pricing structures.

Sugar Beets

Contracting in crop production and marketing is not simply a matter of offering quality incentives. Consider the experience with sugar beets. Contracts cover almost all production; farmers make substantial investments in assets specific to sugar beet production, markets for beet purchase are local, and there are scale economies in processing.

But contract terms vary among buyers, and one type of contract appears to have important effects on beet quality and production value. Recent research documents those effects and explains why only some buyers offer this contract. The contract is based on the facts that sugar beets are valued for the sugar recovered from them and that the amount recovered depends not only on sugar content, but also on the level of impurities present in the beets. Impurities transform sugar into molasses, reducing the sugar actually recoverable. Growers can affect impurities through their agronomic practices, including the timing of planting, fertilizer application, crop rotations, and weed, disease, and insect control.

Balbach (1998) studied the industry's contractual designs and noted that the three processors organized as grower-owned cooperatives used a different contract than the investor-owned processors. Payments in contracts offered by investor-owned firms varied with sugar content, while the "extractable sugar" contracts used by cooperative processors provided additional incentives to reduce impurities as well. The cooperative processor measures the impurities in a random sample of the grower's beets and estimates the percentage of sugar that will be lost due to the molasses created by impurities. The contract terms pay according to beet sugar content minus the percent of loss. Balbach used one cooperative's data to show that average sugar losses to molasses (impurities) fell by 36 percent after introduction of extractable sugar contracts in the 1970s, while actual sugar production per ton of beets rose by 12 percent, representing significant changes in quality and value. In turn, the share of overall production shifted sharply toward the three cooperatives after 1980, as better quality beets reduced their costs of sugar production.

Organizational structure affects contract choice. Extractable sugar contracts require an additional measurement of beet quality—the percentage of sugar loss due to molasses. Balbach argues that processors have an incentive to underreport quality, thereby retaining the higher returns specified in the contract. However, growers form the boards of cooperative processors, holding the right to monitor measurement and reporting processes. If cooperatives themselves underreport quality, the resulting increased cooperative processor returns would still be to growers' benefit as owners. In contrast, investor-owned processors have been unable to assure growers that impurity measures will be accurately and fairly reported, and their growers have avoided extractable contracts. In short, proper contract design also depends on who administers tests for quality, an issue not yet faced in the short-lived experiment with tobacco contracts.

Processing Tomatoes

Almost all U.S. processing tomatoes are grown in California, the vast majority under contracts. There are few participants in the California market—51 processors in the 1990s and about 500 growers, with the 50 largest growers accounting for 40 percent of production (Hueth and Ligon, 2002). Processors usually purchase from nearby growers, substantially limiting the number of potential participants in any transaction, and different processors desire different tomato characteristics for their paste, juice, sauce, ketchup, or soup products. These market characteristics lead to reliance on contracts, with the contract design providing incentives to growers to produce the tomato characteristics desired by buyers.

Hueth and Ligon investigated contract design in a large sample of processing-tomato contracts. Contracts offer premiums and deductions for a variety of tomato characteristics, including weight, the proportion of unripe tomatoes, sugar content, color, and several indicators of damage, including mold, worms, soft spots (rot), and material other than tomatoes (vine parts, dirt, stones, etc.) that may make up part of a load. Actual patterns of contract premiums and deductions vary by processor, year, and grower. Hueth and Ligon found that quality characteristics vary widely across tomato loads and that differences in contract incentives account for a substantial amount of that variation. Moreover, incentives operate in expected directions: increases in premiums associated with specific quality measures are associated with improvements in those measures.

As with sugar beets, product quality must be established by testing random samples of the tomatoes. It appears that, in tomato contracts, effective quality incentives have been achieved by blending contract design with use of an independent quality assurance agency, the Processing Tomato Advisory Board, which is jointly funded by growers and processors and operates grading stations around the State.

Identity-Preserved Corn

Identity-preserved (IP) corn varieties provide specific traits (such as higher oil content) or are produced and marketed in such a way as to retain certain characteristics (for example, by a set of production and marketing techniques like those underlying organic corn). They are IP because they retain identities separate from other grains in the marketing channel, and they include high-oil, nutritionally enhanced, and high-lysine corns primarily used in animal feeds; waxy and high-amylose corns for wet corn milling applications; corn marketed as organic and non-biotech; white and hard endosperm/food grade corns used in dry milling for food products; and seed corn.

IP corns are costlier to produce and market than conventional varieties, both because of the need to preserve identity and because they sometimes have lower yields. Contracts are widely used and cover 75 percent of IP corn production, in contrast to 13 percent of all corn production (table 5-3). Participants use contracts because there often are few nearby buyers, given the specialized nature of IP corn types, and because higher costs expose them to risks of holdup in spot markets. Those with alternative outlets, such as high-oil corn producers who can turn to on-farm feeding, contract less.

Contracts provide an outlet and ensure premiums, usually specified as a per bushel amount above a spot price, to account for costs and yield effects. But contract pricing structures may not accurately capture yield effects, and premiums may not fully offset the yield risks for the fraction of growers (often 10-20 percent) who report substantially lower yields.

As a result, there is great deal of turnover in IP corn production. Thirty percent of producers in 2000 did not return in 2001, and 27 percent of 2001 producers did not return in 2002. Most of those producers are replaced by new entrants, although the U.S. Grains Council, an industry group, reports a declining absolute number of value-enhanced producers in 2001 and 2002.

Table 5-3—Contracting in identity-preserved corn

Identity-preserved corn type	Contract share (percent)		Average premium	Extra costs due to identity preservation: Technology fee	Extra costs due to identity preservation: All else
	Farms	*Bushels*	*Cents/bu*	*Cents/bu*	*Cents/bu*
Seed	93.4	93.2	233	na	136.9
Waxy	76.9	97.6	17	na	2.7
White	74.1	81.9	26	6.4	9.1
High oil	56.6	73.9	21	7.3	1.3
Hard endosperm/ foodgrade	80.1	52.2	15	9.4	3.0
Marketed as non-biotech	11.9	38.8	14	9.4	3.4
All surveyed					
IP types	54.7	74.4	-	-	-
All corn	na	12.8	-	-	-

na = not available.

Source: 2001 USDA Agricultural Resource Management Survey (ARMS).

IP corn contracts may need to evolve over time to adjust for the precise nature of yield effects if the problem is not a lower average yield for all, but rather sharply lower yields for some. Future contract designs may need to transfer technological knowledge to reduce yield risks or include provisions to share yield risks. If the risks are idiosyncratic, contracts need to be structured to select those growers that can most effectively produce value-enhanced grains, perhaps using the relative performance features of broiler contracts.

A similar set of issues offsets the spread of contracts in wheat production. Several observers note that spot market wheat prices fail to provide proper incentives to produce wheat qualities that end-users value (Lambert and Wilson, 2003). Yet contracts covered only 5.5 percent of U.S. wheat production in 2001, down from 9.1 percent in 1996-97 (table 2-6). It has proved difficult to design contracts with the right grower incentives and still provide buyers with specific qualities of wheat in substantial volumes.

Contracts Continue To Evolve

The transactions-cost framework for analyzing contracts describes circumstances under which contracts can improve productivity, either through reducing production and processing costs or by improving product quality and value. Crude aggregate evidence suggests that contracting and organizational innovations may have played a role in agricultural productivity growth, and the empirical evidence from broilers and hogs indicates that the effects can be large.

Modern crop-marketing contracts often aim to provide producers with stronger incentives to deliver products with specific characteristics, through payment schemes that provide premiums for meeting quality targets. But our examples suggest that it is not easy to develop contract designs that provide appropriate quality incentives. Contract designs may need to evolve over time to meet new challenges, and contracts may require the presence of other factors, such as independent quality assurance providers, to work well.